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ABSTRACT

An approach to evaluating the appropriateness of student effort within a mastery instructional system was developed, and the interrelationship of achievement motivation, effort and achievement was investigated. In support of a prominent theory of classroom learning, appropriate effort was strongly correlated with student achievement even when differences in student aptitude were controlled. Finally, achievement motivation was shown to be related to both the effort and achievement variables. A path analysis indicated that the influence of achievement motivation on achievement was determined primarily by the relationship of achievement motivation and effort. (Author)

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Achievement Motivation as a Predictor of Effort and Achievement in a Mastery Learning Course

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The Interrelationship of Achievement Motivation, Persistence and Achievement in a Mastery Instructional System

The study of indiviudal differences in the need to achieve has resulted in a prominent theory of motivation (Atkinson & Feather, 1966). While this theory has generated a vast amount of successful research attempting to explain individual differences in task performance and persistence (Atkinson & Raynor, 1974; Feather, 1962), summaries of the attempts to apply the theory and methods of achievement motivation research within educational settings have drawn fairly disappointing conclusions (Farley, 1972; Lavin, 1965; Vidler, 1977). Among the reasons Lavin (1965) gave in accounting for this situation was the probability that many variables interact with or mediate the impact of achievement motivation in an educational context. Similarly, Atkinson (1958) claimed that motivation for academic achievement may be overdetermined with the influence of other variables masking the potential impact of differences in achievement motivation. The intent of the present study is to investigate the impact of achievement motivation within a learning environment which should theoretically reduce the influence of some traditionally important educational variables (e.g., student aptitude). The learning environment which was provided should thus reduce the difficulties proposed by Atkinson (1958) and Lavin (1965).

The present study employed a mastery instructional system. Although there are many varieties of this approach, mastery oriented systems incorporate some major subset of the following components: (a) clearly defined educational objectives, (b) small, discrete units of study, (c) demonstrated competence before progress to later hierarchically related units, (d) criterion-refer-

enced rather than norm-referenced evaluation, and (e) remedial activities keyed to student deficiencies (Block, 1974). A combination of these components has been claimed to place a much greater emphasis on student work habits and perseverance than traditional instructional methods (Good & Brophy, 1977) and there is a limited amount of empirical support for this claim (Born & Davis, 1974; Latta, Dolphin & Grabe, in press). Carroll (1963) has provided a theoretical rationale which can be used to account for the special importance of student effort in mastery instructional systems. Carroll claims that student achievement can be predicted from the ratio of the amount of time a student spends on learning tasks to the amount of time the student requires for those tasks. Of the several factors which relate to the amount of time the student spends, the student's own persistence is probably most obvious. A second factor, often overlooked but of great potential importance, is the amount of time a given instructional methodology allows the student to spend. If a method of instruction does not allow the student to spend the amount of time required, the student's performance will be limited by the speed at which the student is able to learn (i.e., traditional aptitude). If the amount of time available is greater than the amount of time required, learning will be mostly limited by the student's persistence. Carroll (1970) has come to regard the student's willingness to spend the time required for learning as the most basic motivational issue in educational practice. In relating Carroll's theory to the mastery approach, it should be obvious that a special advantage of this methodology is that the mastery approach is flexible in the amount of time students are allowed to spend in the process of learning. With this additional flexibility, the student's desire to be successful should

take on added significance.

This research could be said to involve two basic goals. The first goal could be briefly summarized as an attempt to demonstrate the importance of student effort in determining achievement within a mastery system and the second as an attempt to relate differences in achievement motivation to both academic effort and achievement. The quantification of student effort was a major obstacle in attacking both goals. There exist but a few attempts to directly record student effort (i.e., study time) (Born & Davis, 1974; Johnston, Roberts & O'Neill, 1972). However, within the large lecture environment of the present experiment, these approaches did not seem applicable. In addition, it is not simply study time which is at issue. Rather, it is the amount of time spent relative to the amount of time required. A modified mastery learning system was developed to provide some indirect evidence of a student's willingness to expend the needed effort. In this system of instruction, mastery of current material before progress to later material was not required, it was made optional. Secondly, the student was given only two opportunities to be tested on a unit of material and one of these opportunities had to be taken outside of normal class time. Finally, students were given feedback on first quiz performance but were on their own in remediating whatever deficiencies existed. This modified mastery system allowed the student to compensate for a lack of ability with extra effort, but it also allowed the student freedom not to extend the system to its limit in obtaining a maximum grade. This freedom to make mistakes is important in light of Atkinson's (1958) claim that achievement motivation may not predict achievement when the subject's behavior is overdetermined. Certain errors students could make in maximizing their potential grades have been operationally defined and it is this type of variable which

will be employed in the proposed analyses.

Method

Instructional Procedures and Subject Description

The participants were 106 students enrolled in the author's undergraduate educational psychology course. Most students in the course were satisfying a mandatory requirement for teacher certification.

The course was taught by a modified mastery method. In this instructional approach, the semester was divided into 7 two-week units and the student was provided a study guide emphasizing priority information within the readings and lecture material of each unit. At the end of each unit students were given a 15 point quiz. Two days after the quiz had been corrected and returned, the student had the opportunity to retake a new quiz on the same unit of material. Retakes were made available to students on a voluntary drop-in basis for a period of three regularly scheduled hours. If the student completed both quizzes, the best score was counted in computing a final grade. In addition to the seven quizzes, the student also took a 30 point midterm and a 50 point comprehensive final. Both the midterm and final were not repeatable. Grading was on the basis of total accumulated points and was determined according to preset standards of achievement.

Variables Under Consideration

Student Grade Point Averages (GPA) and American College Test (ACT) scores were obtained from the Registrar's Office. For various reasons, these data were not available for every student.

Students were also given extra course credit for completing a postcourse questionnaire and Mehrabian's (1968) Resultant Achievement Motivation (RAM)

scale. Postcourse questionnaire results were available from 82 students and RAM data from 77 students. Two questionnaire items were selected for analysis because these items provided some indication of the strategy a student had used in responding to the opportunities the mastery system provided. The student was asked to indicate the percentage (0, 25, 50, 75, 100) which most closely indicated the proportion of times a statement closely described their behavior. The two statements read as follows: (a) I prepared for each quiz as thoroughly as possible. The availability of retakes did not reduce my study time. (b) Material causing a problem on the quiz was restudied before a retake was attempted.

Students who volunteered were given the Mehrabian (1968) scale about halfway through the semester. The Mehrebian scale has demonstrated sufficient reliability and validity in other studies (Latta, 1978; Mehrabian, 1968) to warrant its use in this experiment. The items on the RAM scale were responded to on a 5 point scale (1 = least agreement, 5 = most agreement).

The intent in operationally defining the variables measuring student effort was to describe mutually exclusive ways in which the student could fail to fully utilize the mastery system to obtain a satisfactory grade (i.e., C) or could utilize the system in attempting to obtain a high grade (i.e., A or B). Three variables measuring lack of effort and one variable indicating extra effort were defined. Using the preset grading standards, effort errors were defined as: (a) earning a C or less on the initial quiz and failing to attempt a retake (FTAKE), (b) skipping the first quiz attempt and earning a C or less on the retake (SKIP), and (c) earning a D or less on the initial quiz attempt and not improving on the retake by at least one point (FIMP). The total number of effort errors (ERRORS) was used to reflect the sum of these three variables.

In order to obtain an indication of the success of students in avoiding effort errors, potential errors (POTENTIAL) were defined as the total number of initial quiz attempts at or below the C level and a ratio (RATIO) relating ERRORS to POTENTIAL was calculated. Extra effort was described as earning a B or above on the initial quiz attempt and still completing a quiz retake (EXTRA). Finally, total effort (EFFORT) was calculated by subtracting ERRORS from EXTRA.

Two variables were used to measure student achievement. The first (SUM) indicated the total score on the midterm and final. The second (GRADE) indicated the total number of points earned on the two major tests and seven quiz situations.

Analyses

The intent of the first set of analyses was to demonstrate the importance of RAM in predicting differences in the persistence and achievement measures. To accentuate the impact of RAM, comparisions were made between the extreme thirds of the RAM distribution. The bottom and top groups were defined by scores (RAM $\leq$ 2 or $\geq$ 8) most evenly dividing the distribution into three equal segments. There were 27 students in the high RAM group and 26 students in the low RAM group. The *t*-test procedure was used to compare the high and low RAM groups on the operationally defined achievement and effort variables. A chi-square procedure was used to compare the responses of these two groups to the two postcourse questionnaire items.

The second type of data presentation involved the construction of a correlation matrix interrelating the variables of major interest. Because students completed the RAM scale on a voluntary basis, there existed the possi-

bility that a nonrepresentative group was chosen in this fashion. To investigate this possibility, separate correlation matrices were constructed for both the total sample and the sample completing the RAM scale. Because the correlations involving the achievement measures and EFFORT were so important to the basic argument of this research, these correlations were singled out for further investigation. One possible confounding in the proposed methodology was that the assumed relationship between the achievement measures and EFFORT may have been biased by differences in student aptitude. Perhaps more able students would make fewer effort errors and also earn higher grades creating a spurious correlation between EFFORT and GRADE or EFFORT and SUM. To test this possibility, partial correlations removing the influence of ACT and GPA were performed.

Finally, a proposed model relating RAM, EFFORT and GRADE was evaluated using path analysis (Kerlinger & Pedhazur, 1973, pps. 305-331). It was expected that there would be little direct influence of RAM on GRADE. Rather, the impact of RAM on GRADE was anticipated as an indirect influence through the EFFORT variable. The selection of GRADE as the measure of achievement was based upon the assumption that the student's goal is to maximize the total number of points earned. A single test score like the course final may reflect the impact of various strategy decisions (Hanni, 1977), but one can be fairly certain that most students have a similar goal in mind regarding their final grade.

Results

The group means and t values resulting from the high and low RAM comparisons appear in Table 1. In support of the predicted superiority of the high RAM subjects, all comparisons were in the hypothesized direction and only two

comparisons failed to reach an acceptable level of statistical significance ($p \leq .05$).

Insert Table 1 about here

Responses to the two postcourse questionnaire items were analyzed using a chi-square procedure. The high and low RAM groups did not differ, X^2 (4) = 6.76, in their responses to the question about preparation for the initial quizzes. The two groups did differ, X^2 (4) = 13.29, $p \leq .01$, in response to the item requesting information about preparation for the retakes. The group difference responsible for the significant outcome can be illustrated by the fact that 73 percent of the high RAM group and only 16 percent of the low RAM group claimed to have always restudied material missed on the initial quiz before attempting a retake.

The zero-order correlations among the variables of major interest appear in Table 2. The correlations have been computed separately for the entire class and for the sample completing the RAM scale. Only small differences can be observed between these two sets of data. Several of these correlations are of special importance to the central theme of this research and warrant further comment. The measure of achievement motivation was significantly related to GRADE and to the variables summarizing student effort. However, the magnitude of the correlations was in most cases rather small. In contrast, the measures of student effort and course achievement produced some correlations of striking magnitude. For example, ERRORS correlated with GRADE $r = -.86$ and with SUM $r = -.67$. EFFORT, the cummulative measure of student persistence, was found to be correlated with GRADE $r = .73$ and with SUM $r = .53$.

Insert Table 2 about here

Because an understanding of the correlations between EFFORT and the measures of achievement was considered one of the central concerns of this research, the nature of these relationships was studied further by attempting to partial out the influence of several measures of student aptitude. The correlations of GRADE and EFFORT when controlling for the designated aptitude measures were as follows: (a) ACT r = .77 (df = 45), (b) GPA r = .71 (df = 81), and (c) ACT and GPA r = .68 (df = 45). The same calculations for SUM and EFFORT were: (a) ACT r = .58 (df = 45), (b) GPA r = .43 (df = 81), and (c) ACT and GPA r = .44 (df = 44). It is important to note in interpreting these results that each calculation was based upon a slightly different sample of subjects. In the most restricted group, EFFORT was correlated with GRADE r = .77 and with SUM r = .58. The inclusion of aptitude measures thus did little to reduce the zero-order correlations.

The final result involves a path analysis procedure. This technique allows the researcher to construct a model from several variables and then analyze the proposed relationship among these variables into direct and indirect effects. The magnitude of direct effects is determined by path coefficients, which are standardized partial regression weights. As can be seen in Figure 1, RAM has no direct influence on GRADE. Rather RAM is related to EFFORT which in turn is strongly related to GRADE. The influence of achievement motivation on achievement is thus basically a matter of motivation influencing perseverance.

Insert Figure 1 about here

Discussion

This study involved two basic goals. The first was to demonstrate the importance of student effort in predicting achievement within a mastery learning system. The second goal was to investigate the interrelationship of one measure of achievement motivation and measures of both student effort and academic achievement. While it may seem that the first goal is just a component of the second, the two issues are being presented separately because each issue relates to a different theoretical concern.

Carroll (1963) theorized that most students could learn what was expected of them if the instructional system provided a sufficient amount of time and the student would spend what was necessary of the time available. In an attempt to evaluate this proposal, students were provided with a flexible learning system and were allowed to use the system as they wished. Effort was operationally defined in terms of variables indicating the student's failure to take full advantage of the system or to utilize the system in an attempt to improve an already acceptable grade. Effort as measured by these operationally defined variables was found to be strongly related both to course grade and to scores on the major course examinations. In addition, attempts to reduce the correlation of effort and achievement by controlling for differences in student aptitude proved to have little impact on the magnitude of the original relationship. Regardless of ability, students taking advantage of what the learning system allowed and their personal situation required earned higher grades. While it may be true that students of lower ability are more

likely to find themselves in a position to make more effort errors, the data seem to indicate that if the student is persistent, these potential error situations can be eliminated or avoided and the student's ability to learn the material is not diminished. The Carroll model appears valid in this mastery learning system.

One potential problem exists in interpreting the correlation of student effort and course achievement. Because effort is defined in terms of quiz behavior and quiz performance is a sizeable determinant of final grade, the correlation of EFFORT and GRADE is probably inflated to some degree by this redundancy. Whether or not this correlation is meaningful is thus somewhat at issue. There are two reasons to lend at least some credibility to this result. First, the defined measures of effort do not directly measure student quiz performance, but are intended to describe quiz taking behaviors. The following statements are intended as illustrations of this distinction: (a) a student may obtain a failing score for a unit without generating an effort error, (b) an EXTRA effort credit does not guarantee an increase in unit quiz points, and (c) both FIMP and FTAKE errors are much more likely following marginal rather than very poor initial quiz performance. Secondly, it can be shown that the various summary measures of effort correlate nearly as well with major exam performance as with total course performance. Because the major exams are independent of the method for defining student effort, this relationship could not be due to a methodological artifact. The fact that sizeable correlations can also be obtained with a second measure of performance implies that the relationship of EFFORT and GRADE was probably not seriously inflated. The purpose of retaining GRADE in spite of the potential hazards is that this research centers on issues of student motivation and course performance is

the variable students are most motivated to maximize. As was stated previously, researchers have often inappropriately employed the course final as the only dependent variable in research of this nature. It might be assumed that the final examination is only important to the student to the extent that it might alter the grade the student has established. While other data will be provided, GRADE will remain the basic dependent variable in the discussion to follow.

The second major goal of this research was to determine if individual differences in achievement motivation could be related to differences both in academic effort and achievement. Like much of the published data on this topic, the correlational results could be described as weak, but significant. One is forced to conclude from these data that either the link between motivation and achievement is of little importance or that the methodology used in this and other field research is in some way deficient. In support of the second possibility, Lavin (1965) has listed several limitations of research on academic achievement. In addition to the previously mentioned comment on the complexity of the academic situation, Lavin also claimed that measures of achievement motivation were of poor quality and that perhaps motivation should be measured relative to a particular area of achievement. Without the benefit of precise measures of academic achievement motivation, perhaps the rather crude strategy of comparing groups deviating widely on the assessment instrument is most appropriate. This is certainly the most common practice in laboratory experiments. The comparisons of this type, particularly with some of the measures of student effort, were impressive. Groups of students differing in achievement motivation were found to differ in points earned toward a final grade, several measures of quiz taking errors, extra quiz effort,

and a questionnaire item assessing the student's strategy in studying for the retakes. The difference in final accumulated points was approximately equivalent to one letter grade. In addition, the comparison of ratios relating actual to potential effort errors demonstrated that the error results were not simply a matter of poorly motivated students more frequently being exposed to potential error situations. The low motivation group also seemed less determined to prevent potential error situations from developing into actual errors. In several different ways, this research has demonstrated that students low in achievement motivation more frequently make observable choices which could limit their ultimate academic achievement. Perhaps the best summary of these data is that achievement motivation was certainly related to academic effort and maybe also related to academic achievement. By incorporating the path analysis results this summary can be extended to indicate that whatever the impact of achievement motivation on academic achievement, the relationship is indirectly determined through differences in student effort.

Assuming that the impact of achievement motivation on course performance is strong enough to warrant concern, consider some of the possible implications. Poorly motivated students did not seem to be as able to take full advantage of the opportunities provided them in the flexible environment of the present study. Perhaps these results could be interpreted to mean that individuals who are low in achievement motivation should be educated in a more structured way. Even if this conclusion is valid, it may suggest a short sighted solution. Some of the factors developmentalists (Crandall, Preston & Rabson, 1960; Winterbottom, 1953) claim to be associated with the socialization of achievement striving include allowing independence and rewarding achievement oriented

effort. Perhaps certain mastery and individualized instructional approaches provide a learning environment similar in some ways to the home environment of highly motivated children. If the student's attitudes toward academic achievement have not already been fixed, the long term impact of mastery approaches may be to develop academic achievement motivation.

Aside from the major issues raised here, this study presented a new approach to the quantification of student effort. Because these defined variables could be related both to student achievement motivation and actual achievement, the variables fill an important niche in an intuitively satisfying model of classroom performance. Further research might profitably investigate other situational or individual difference variables impacting on these measures of student effort.

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Table 1

Comparison of Achievement and Effort Means for High and Low RAM Groups

Variable	Group		t Value
	High RAM	Low RAM	
SUM	64.3	61.5	1.39
GRADE	159.0	151.2	2.31*
ERRORS	.96	2.54	-3.60*
FTAKE	.41	1.46	-3.57*
FIMP	.30	.35	- .25
SKIP	.26	.73	-2.03*
POSSIBLE	3.15	4.15	-2.01*
RATIO	.22	.56	-4.21*
EXTRA	2.78	1.35	3.33*
EFFORT	1.81	-1.19	4.18*

*Indicates significant comparison, $p \leq .05$

Table 2

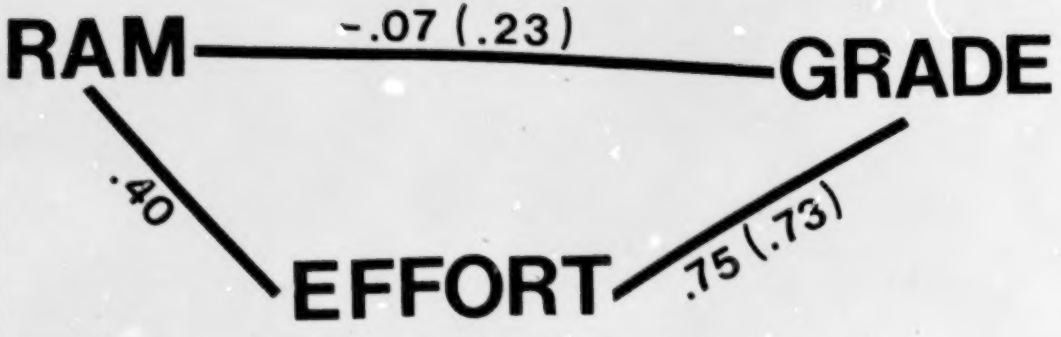
Zero-Order Correlation Matrix

	SUM	GRADE	ERRORS	FTAKE	FIMP	SKIP	EXTRA	EFFORT	RAM
SUM	----	.91	-.67	-.59	-.19	-.29	.24	.59	.15
GRADE	.91	----	-.86	-.70	-.21	-.51	.39	.73	.23
ERRORS	-.69	-.86	----	.85	.28	.52	-.54	-.89	-.31
FTAKE	-.60	-.72	.86	----	-.08	.13	-.51	-.79	-.22
FIMP	-.20	-.19	.22	-.07	----	.01	-.02	-.18	-.03
SKIP	-.35	-.53	.57	.19	-.05	----	-.27	-.46	-.28
EXTRA	.32	.46	-.58	-.55	-.02	-.32	----	.86	.41
EFFORT	.59	.77	-.91	-.81	-.15	-.52	.86	----	.40

Correlations above the diagonal are for those subjects completing the RAM scale. In this sample (n = 77), a correlation coefficient of .19 is necessary for significance ($p \leq .05$). Correlations below the diagonal are for the total sample. In this sample (n = 106), a correlation coefficient of .15 is necessary for significance ($p \leq .05$).

Figure Caption

Figure 1. Path Analysis Results (Values in parentheses represent zero-order correlations. The other values are path coefficients).


RAM
-.07 (.23)
GRADE
.40
EFFORT
.75 (.73)